INTRODUCTION

An adequate supply of good quality water is a vital element of most farming enterprises. It is essential for maintaining stock health, maximising animal and plant production and providing a good supply for house and garden use.

The quality of farm water across Victoria varies enormously depending on its source, storage and distribution. Underground water across much of the state has excessively high levels of salt, while rain collected off a clean roof usually provides very high quality water.

The quality of water also determines its potential use. Water with a salinity level greater than 22,000 EC (µs/cm) is generally unsuitable for livestock while water with a salinity level of less than 300 EC (µs/cm) can be used for most livestock and for irrigating most types of plants.

MANAGEMENT STRATEGIES

Many water quality issues are associated with the collection, storage and reticulation of water. Storing water from underground sources in dams can result in a rapid deterioration of water quality due to evaporation and the associated concentration of dissolved salts. Unfenced catchment dams can be easily fouled by stock wading and defecating in the water. Poorly vegetated catchment areas can result in significant quantities of organic matter, manure, fertiliser and soil entering the water supplies.

The following strategies can help to maintain good water quality:

- Store saline water in tanks rather than in dams
- Fence off dams and reticulate water into troughs for stock
- Protect dam catchments with good ground cover and maintain a grassed filter strip at the dam inlet
- Clean troughs regularly
- Establish windbreaks adjacent to dams to reduce evaporation
- Construct sediment traps to protect dams during high risk periods

For more information refer to the Agriculture Note AG1399: Minimising algal growth in farm dams.

WATER QUALITY ISSUES

There are numerous ways water quality is assessed. This AgNote covers some of the more common issues associated with water for agriculture use:

- Turbidity
- Hardness
- Acidity (pH)
- Algae and aquatic plants

SALINITY

Salinity refers to the concentration of soluble salts in soil or water. All natural waters contain some dissolved salts such as sodium, magnesium and calcium. Sodium chloride (table salt) is the most common of all the salts; it is the main constituent of seawater. The level of salt in water affects its suitability for irrigation, stock and domestic use. Salts based on calcium and magnesium also affect the hardness and alkalinity of water.

Farm water supplies are commonly measured using an Electrical Conductivity (EC) meter. These meters use the electrical conductivity of a water sample to estimate the total salt concentration. EC meters cannot identify the types of salt in solution. EC meters measure conductivity using a variety of units depending on the model and salt concentration of the water. In Victoria EC units are usually expressed as: microSiemens per centimetre (µs/cm). Further information is provided in AgNote LC0064: Measuring the salinity of water.

As the salinity level of water rises it becomes increasing difficult for the cells of plants and animals to absorb water, which can lead to dehydration and in some cases death.

The relationship between the salt concentration of irrigation water and plant growth is quite complex. It varies depending on the plant species, variety, stage of growth and soil drainage characteristics. A deep, well drained soil can handle a significantly higher level of salt than a poorly drained soil. Salts such as chloride, sodium and boron can also become toxic to plants at elevated levels of salinity. Table 1 summarises the effects of water salinity on plants.

The tolerance of livestock to salinity also varies significantly depending on species, age, condition, feed type and stage in the breeding cycle (Refer to Table 2: Salinity tolerance levels for livestock water). Mature dry sheep can tolerate salinity levels to about 20,000 EC (µs/cm) while pigs and poultry can only tolerate salinity levels to about 6,000 EC (µs/cm). It is important that stock are introduced slowly to highly saline water to avoid health issues, weight loss and reduced production.

As with plants, some particular salts can also cause problems with stock. In the past ill-health of cattle and sheep in south western Victoria has been attributed to excessive levels of magnesium in underground water supplies. Landholders in this area should get water tested for magnesium if EC levels exceed 10,000 µs/cm or if this problem is suspected.
Table 1: Effects of water salinity on plants

<table>
<thead>
<tr>
<th>EC range (µS/cm)</th>
<th>Effect and suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 300</td>
<td>Low salinity water – can be used for most crops on most soils with all methods of water application. Little likelihood that a salinity problem will develop.</td>
</tr>
<tr>
<td>300 - 800</td>
<td>Medium salinity water – can be used if a moderate amount of leaching occurs. Plants with a medium salt tolerance can be grown, usually without special practices for salinity control.</td>
</tr>
<tr>
<td>800 – 2,500</td>
<td>High salinity water – cannot be used on soils with restricted drainage. Even with adequate drainage, special management for salinity control may be required. The salt tolerance of the plants to be irrigated must be considered.</td>
</tr>
<tr>
<td>2,500 – 5,800</td>
<td>Very high salinity water – not suitable for irrigation under ordinary conditions. For use soils must be permeable with adequate drainage. Water must be applied in excess to provide considerable leaching. Salt tolerant crops should be selected.</td>
</tr>
<tr>
<td>Above 5,800</td>
<td>Extremely high salinity water – occasional emergency use for salt tolerant crops on permeable well drained soils under good management. High rates of leaching are required.</td>
</tr>
</tbody>
</table>

Source: Adapted from Victorian Irrigation Research and Advisory Committee, 1980, book, Quality aspects of farm water supplies.

TURBIDITY

Turbidity is caused by solid materials being suspended in the water column. These materials include clay, silt, fine organic matter and microscopic organisms (predominately living algae). As well as having a number of physical impacts, highly turbid water is likely to have elevated levels of phosphorus; a key factor in producing algal blooms. Turbidity is measured by how much light can pass through a sample of water.

Materials suspended in water can cause:

- Sedimentation in pipes, tanks, hot water systems and other equipment
- Staining of clothes, washed surfaces etc.
- Clogging of fine tubes in air conditioners, spray nozzles and micro-irrigation systems
- Unpleasant colour and smell
- Chlorination systems to become ineffective
- Reduced herbicide performance

Turbidity is measured in NTU’s (Nephelometric Turbidity Units). Clear water will have a measure of approximately 1 NTU, slightly cloudy water approximately 10 NTU, very cloudy water greater than 50 NTU. To avoid the formation of sludge in pipes, tanks and hot water systems, turbidity levels should be kept below 5 NTU.

Table 2: Salinity tolerance levels for livestock water

<table>
<thead>
<tr>
<th>Type</th>
<th>Production decline begins EC (µS/cm)</th>
<th>Maximum EC (µS/cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poultry</td>
<td>3,100</td>
<td>6,250</td>
</tr>
<tr>
<td>Pigs</td>
<td>3,100</td>
<td>6,250</td>
</tr>
<tr>
<td>Horses</td>
<td>6,250</td>
<td>10,900</td>
</tr>
<tr>
<td>Dairy cattle</td>
<td>4,700</td>
<td>9,300</td>
</tr>
<tr>
<td>Beef cattle</td>
<td>6,250</td>
<td>15,600</td>
</tr>
<tr>
<td>Lactating ewes, weaners</td>
<td>6,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Sheep, dry feed</td>
<td>9,300</td>
<td>21,800</td>
</tr>
</tbody>
</table>


HARDNESS

Hardness describes the amount of calcium and magnesium salts in water. It affects the capacity of water to form a lather with soap or detergents. Hard water often causes a scum to form, such as on hands and the inside of pipes and other plumbing fittings. It can also cause yellowing of clothing. Hardness can be a significant problem in hot water systems where a deposit of calcium carbonate can form inside the tank and on associated pipework. Hardness can also affect the use of some farm chemicals. Table 3 describes various hardness levels for farm and domestic use. Hardness is expressed as the amount of calcium carbonate (CaCO₃) in a water sample. It can be tested at an appropriate laboratory, with a portable test kit or with the use of test strips.
Table 3: Hardness levels

<table>
<thead>
<tr>
<th>Hardness mg/L CaCO₃</th>
<th>Effect and suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 60</td>
<td>Soft, but possibly corrosive</td>
</tr>
<tr>
<td>60 – 200</td>
<td>Hard, but acceptable for most uses</td>
</tr>
<tr>
<td>200 – 500</td>
<td>Very hard with increasing scale problems</td>
</tr>
<tr>
<td>&gt;500</td>
<td>Extremely hard, severe scaling</td>
</tr>
</tbody>
</table>


Acidity Levels (pH)

The pH of water is a measure of how acidic or alkaline the water is on a scale of 0 to 14. Readings below 7 are acid, above 7 are alkaline. 0 is the most acid; 14 the most alkaline. Distilled water has a pH of 7 which is called neutral. pH is a measure of the relative amount of hydrogen and hydroxide ions in a solution.

The pH of water affects its suitability for domestic, irrigation and chemical use. For irrigation, garden and household use, the pH should be in the range 6.5 – 8.5. Corrosion of pipes and plumbing fittings can occur below 6.5. Scale may form at levels above 8.5 and corrosion may occur at levels above 11.

The pH of water can affect the performance of some farm chemicals. Always check the manufacturer’s instructions to assess its suitability for mixing with a particular water source.

ALGAE AND AQUATIC PLANTS

Algae describes a diverse group of microscopic organisms that can accumulate together in large numbers to form a brown, yellow or green scum (or bloom) on the surface of a water body. Algae and aquatic plants found on farms are a natural part of the environment and play an important role in the ecosystems of lakes, rivers, wetlands and farm dams.

However excessive growth of algae and aquatic plants can cause problems by blocking pipes, preventing stock access and making the water unpalatable to stock.

Excessive growth of algae and aquatic plants is also an indicator of high nutrient levels in the water which is commonly the result of sediment, organic matter, fertilizer or manure washing into the water body.

One group of algae commonly known as blue-green algae (cyanobacteria) can present a serious health risk to humans and stock when they accumulate in large numbers. While blue-green algae can sometimes be visibly detected, suspect water samples should be collected and sent to a suitable laboratory for analysis.

The signs of a blue-green algae bloom include the sudden appearance of a vivid green paint- like scum on the surface of a water body, sky blue marks on rocks, plants and around the edges of the dam and a strong earthy or rotten smell. Early on in the infestation, small green flecks may appear in the water. For more information refer to Landcare Note LC0098: Blue-green algae problems in dams.

Conditions favoring the growth of algae and aquatic plants include:

- Abundant nutrients, specifically phosphorus and nitrogen
- Warm, still water
- Extensive sunlight

A number of species of aquatic plants grow in, around and on the surface of a water bodies, such as a farm dam. Common species include cumbungi, cane grass, sedges and azolla. All can be generally controlled using mechanical means.

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